Abstract Submitted
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Direct Laser Writing of Single-Material Sheets with Programmable Self-Rolling Capability[1] ANTON BAUHOFER, SEBASTIAN KRDEL, OSAMA BILAL, CHIARA DARAIO, ETH - Zurich, ANDREI CONSTANTINESCU, Ecole Polytechnique — Direct laser writing, a sub-class of two-photon polymerization, facilitates 3D-printing of single-material microstructures with inherent residual stresses. Here we show that controlled distribution of these stresses allows for fast and cost-effective fabrication of structures with programmable self-rolling capability. We investigate 2D sheets that evolve into versatile 3D structures. Precise control over the shape morphing potential is acquired through variations in geometry and writing parameters. Effects of capillary action and gravity were shown to be relevant for very thin sheets (thickness <1.5um) and have been analytically and experimentally quantified. In contrast to that, the deformations of sheets with larger thickness (>1.5um) are dominated by residual stresses and adhesion forces. The presented structures create local tensions up to 180MPa, causing rolling curvatures of 25E3m^{-1}. A comprehensive analytical model that captures the relevant influence factors was developed based on laminate plate theory. The predicted curvature and directionality correspond well with the experimentally obtained data. Potential applications are found in drug encapsulation and particle traps for emulsions with differing surface energies.

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